

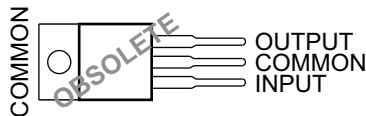
## FIXED POSITIVE VOLTAGE REGULATORS

Check for Samples: [μA7800 SERIES](#)

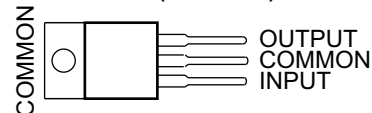
### FEATURES

- 3-Terminal Regulators
- Available in fixed 5V/8V/10V/12V/15V/24V options
- Output Current up to 1.5 A
- Internal Thermal-Overload Protection
- High Power-Dissipation Capability
- Internal Short-Circuit Current Limiting
- Output Transistor Safe-Area Compensation

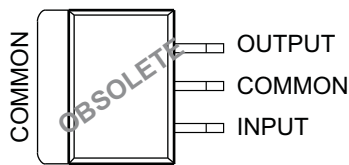
**KC (TO-220) PACKAGE  
(TOP VIEW)**



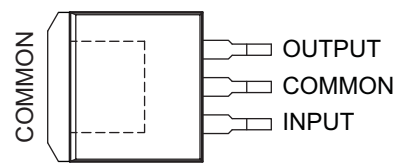
**KCS OR KCT (TO-220) PACKAGE  
(TOP VIEW)**



**KTE (PowerFLEX™) PACKAGE  
(TOP VIEW)**



**KTT (TO-263) PACKAGE  
(TOP VIEW)**



### DESCRIPTION/ORDERING INFORMATION

This series of fixed-voltage integrated-circuit voltage regulators is designed for a wide range of applications. These applications include on-card regulation for elimination of noise and distribution problems associated with single-point regulation. Each of these regulators can deliver up to 1.5 A of output current. The internal current-limiting and thermal-shutdown features of these regulators essentially make them immune to overload. In addition to use as fixed-voltage regulators, these devices can be used with external components to obtain adjustable output voltages and currents, and also can be used as the power-pass element in precision regulators.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

PowerFLEX, PowerPAD are trademarks of Texas Instruments.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of the Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

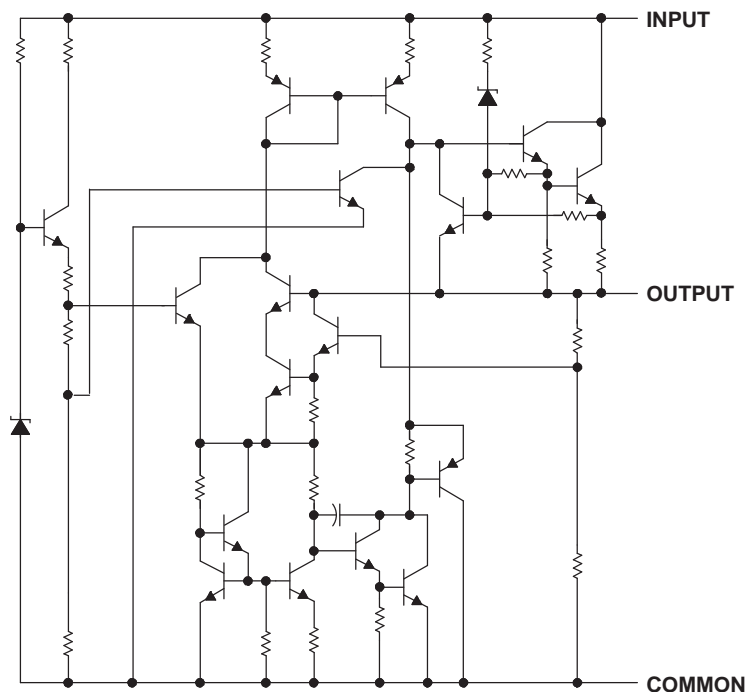
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# ORDERING INFORMATION<sup>(1)</sup>

T <sub>J</sub>	V <sub>O(NOM)</sub>	PACKAGE <sup>(2)</sup>		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 125°C	5 V	TO-220, short shoulder – KCS	Tube of 50	UA7805CKCS	UA7805C
		TO-220, single gauge – KCT	Tube of 50	UA7805CKCT	UA7805C
		TO-263 – KTT	Reel of 500	UA7805CKTTR	UA7805C
		PowerFLEX™ – KTE		OBSOLETE	OBSOLETE
		TO-220 – KC		OBSOLETE	OBSOLETE
	8 V	TO-220, short shoulder – KCS	Tube of 50	UA7808CKCS	UA7808C
		TO-220, single gauge – KCT	Tube of 50	UA7808CKCT	UA7808C
		TO-263 – KTT	Reel of 500	UA7808CKTTR	UA7808C
		PowerFLEX – KTE		OBSOLETE	OBSOLETE
		TO-220 – KC		OBSOLETE	OBSOLETE
	10 V	TO-220, short shoulder – KCS	Tube of 50	UA7810CKCS	UA7810C
		TO-263 – KTT	Reel of 500	UA7810CKTTR	UA7810C
		PowerFLEX – KTE		OBSOLETE	OBSOLETE
		TO-220 – KC		OBSOLETE	OBSOLETE
	12 V	TO-220, short shoulder – KCS	Tube of 50	UA7812CKCS	UA7812C
		TO-220, single gauge – KCT	Tube of 50	UA7812CKCT	UA7812C
		TO-263 – KTT	Reel of 500	UA7812CKTTR	UA7812C
		PowerFLEX – KTE		OBSOLETE	OBSOLETE
		TO-220 – KC		OBSOLETE	OBSOLETE
	15 V	TO-220, short shoulder – KCS	Tube of 50	UA7815CKCS	UA7815C
		TO-220, single gauge – KCT	Tube of 50	UA7815CKCT	UA7815C
		TO-263 – KTT	Reel of 500	UA7815CKTTR	UA7815C
		PowerFLEX – KTE		OBSOLETE	OBSOLETE
		TO-220 – KC		OBSOLETE	OBSOLETE
	24 V	TO-220, short shoulder – KCS	Tube of 50	UA7824CKCS	UA7824C
		TO-263 – KTT	Reel of 500	UA7824CKTTR	UA7824C
		PowerFLEX – KTE		OBSOLETE	OBSOLETE
		TO-220 – KC		OBSOLETE	OBSOLETE

- (1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at [www.ti.com](http://www.ti.com).
- (2) Package drawings, thermal data, and symbolization are available at [www.ti.com/packaging](http://www.ti.com/packaging).

**Figure 1. SCHEMATIC**



## Absolute Maximum Ratings<sup>(1)</sup>

over virtual junction temperature range (unless otherwise noted)

		MIN	MAX	UNIT
$V_I$ Input voltage	μA7824C		40	V
	All others		35	
$T_J$ Operating virtual junction temperature			150	°C
Lead temperature	1,6 mm (1/16 in) from case for 10 s		260	°C
$T_{stg}$ Storage temperature range		–65	150	°C

- (1) Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

## Package Thermal Data<sup>(1)</sup>

PACKAGE	BOARD	$\theta_{JA}$	$\theta_{JC}$	$\theta_{JP}$ <sup>(2)</sup>
PowerFLEX (KTE) – OBSOLETE	High K, JESD 51-5	23°C/W	3°C/W	2.7°C/W
TO-220 (KCS), (KCT) (KC – OBSOLETE)	High K, JESD 51-5	19°C/W	17°C/W	3°C/W
TO-263 (KTT)	High K, JESD 51-5	25.3°C/W	18°C/W	1.94°C/W

- (1) Maximum power dissipation is a function of  $T_{J(max)}$ ,  $\theta_{JA}$ , and  $T_A$ . The maximum allowable power dissipation at any allowable ambient temperature is  $P_D = (T_{J(max)} - T_A)/\theta_{JA}$ . Operating at the absolute maximum  $T_J$  of 150°C can affect reliability.
- (2) For packages with exposed thermal pads, such as QFN, PowerPAD™, or PowerFLEX,  $\theta_{JP}$  is defined as the thermal resistance between the die junction and the bottom of the exposed pad.

## Recommended Operating Conditions

		MIN	MAX	UNIT
$V_I$	Input voltage	μA7805	7	25
		μA7808	10.5	25
		μA7810	12.5	28
		μA7812	14.5	30
		μA7815	17.5	30
		μA7824	27	38
$I_O$	Output current		1.5	A
$T_J$	Operating virtual junction temperature	0	125	°C

## uA7805 Electrical Characteristics

at specified virtual junction temperature,  $V_I = 10\text{ V}$ ,  $I_O = 500\text{ mA}$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_J$ <sup>(1)</sup>	μA7805C			UNIT
			MIN	TYP	MAX	
Output voltage	$I_O = 5\text{ mA to }1\text{ A}$ , $V_I = 7\text{ V to }20\text{ V}$ , $P_D \leq 15\text{ W}$	25°C	4.8	5	5.2	V
		0°C to 125°C	4.75		5.25	
Input voltage regulation	$V_I = 7\text{ V to }25\text{ V}$	25°C		3	100	mV
	$V_I = 8\text{ V to }12\text{ V}$			1	50	
Ripple rejection <sup>(2)</sup>	$V_I = 8\text{ V to }12\text{ V}$ , $f = 120\text{ Hz}$	0°C to 125°C	62	78		dB
	$V_I = 8\text{ V to }12\text{ V}$ , $f = 120\text{ Hz (KCT)}$			68		
Output voltage regulation	$I_O = 5\text{ mA to }1.5\text{ A}$	25°C		15	100	mV
	$I_O = 250\text{ mA to }750\text{ mA}$			5	50	
Output resistance	$f = 1\text{ kHz}$	0°C to 125°C		0.017		Ω
Temperature coefficient of output voltage	$I_O = 5\text{ mA}$	0°C to 125°C		–1.1		mV/°C
Output noise voltage	$f = 10\text{ Hz to }100\text{ kHz}$	25°C		40		μV
Dropout voltage	$I_O = 1\text{ A}$	25°C		2		V
Bias current		25°C		4.2	8	mA
Bias current change	$V_I = 7\text{ V to }25\text{ V}$	0°C to 125°C			1.3	mA
	$I_O = 5\text{ mA to }1\text{ A}$				0.5	
Short-circuit output current		25°C		750		mA
Peak output current		25°C		2.2		A

(1) Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.

(2) This parameter is validated by design and verified during product characterization. It is not tested in production.

## uA7808 Electrical Characteristics

at specified virtual junction temperature,  $V_I = 14\text{ V}$ ,  $I_O = 500\text{ mA}$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_J$ <sup>(1)</sup>	μA7808C			UNIT
			MIN	TYP	MAX	
Output voltage	$I_O = 5\text{ mA to }1\text{ A}$ , $V_I = 10.5\text{ V to }23\text{ V}$ , $P_D \leq 15\text{ W}$	25°C	7.7	8	8.3	V
		0°C to 125°C	7.6		8.4	
Input voltage regulation	$V_I = 10.5\text{ V to }25\text{ V}$	25°C		6	160	mV
	$V_I = 11\text{ V to }17\text{ V}$			2	80	
Ripple rejection <sup>(2)</sup>	$V_I = 11.5\text{ V to }21.5\text{ V}$ , $f = 120\text{ Hz}$	0°C to 125°C	55	72		dB
	$V_I = 11.5\text{ V to }21.5\text{ V}$ , $f = 120\text{ Hz (KCT)}$			62		
Output voltage regulation	$I_O = 5\text{ mA to }1.5\text{ A}$	25°C		12	160	mV
	$I_O = 250\text{ mA to }750\text{ mA}$			4	80	
Output resistance	$f = 1\text{ kHz}$	0°C to 125°C		0.016		Ω
Temperature coefficient of output voltage	$I_O = 5\text{ mA}$	0°C to 125°C		–0.8		mV/°C
Output noise voltage	$f = 10\text{ Hz to }100\text{ kHz}$	25°C		52		μV
Dropout voltage	$I_O = 1\text{ A}$	25°C		2		V
Bias current		25°C		4.3	8	mA
Bias current change	$V_I = 10.5\text{ V to }25\text{ V}$	0°C to 125°C			1	mA
	$I_O = 5\text{ mA to }1\text{ A}$				0.5	
Short-circuit output current		25°C		450		mA

(1) Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.

(2) This parameter is validated by design and verified during product characterization. It is not tested in production.

## μA7808 Electrical Characteristics (continued)

at specified virtual junction temperature,  $V_I = 14\text{ V}$ ,  $I_O = 500\text{ mA}$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_J^{(1)}$	μA7808C			UNIT
			MIN	TYP	MAX	
Peak output current		25°C		2.2		A

## μA7810 Electrical Characteristics

at specified virtual junction temperature,  $V_I = 17\text{ V}$ ,  $I_O = 500\text{ mA}$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_J^{(1)}$	μA7810C			UNIT
			MIN	TYP	MAX	
Output voltage	$I_O = 5\text{ mA to }1\text{ A}$ , $V_I = 12.5\text{ V to }25\text{ V}$ , $P_D \leq 15\text{ W}$	25°C	9.6	10	10.4	V
		0°C to 125°C	9.5		10.5	
Input voltage regulation	$V_I = 12.5\text{ V to }28\text{ V}$	25°C		7	200	mV
	$V_I = 14\text{ V to }20\text{ V}$			2	100	
Ripple rejection <sup>(2)</sup>	$V_I = 13\text{ V to }23\text{ V}$ , $f = 120\text{ Hz}$	0°C to 125°C	55	71		dB
Output voltage regulation	$I_O = 5\text{ mA to }1.5\text{ A}$	25°C		12	200	mV
	$I_O = 250\text{ mA to }750\text{ mA}$			4	100	
Output resistance	$f = 1\text{ kHz}$	0°C to 125°C		0.018		Ω
Temperature coefficient of output voltage	$I_O = 5\text{ mA}$	0°C to 125°C		–1		mV/°C
Output noise voltage	$f = 10\text{ Hz to }100\text{ kHz}$	25°C		70		μV
Dropout voltage	$I_O = 1\text{ A}$	25°C		2		V
Bias current		25°C		4.3	8	mA
Bias current change	$V_I = 12.5\text{ V to }28\text{ V}$	0°C to 125°C			1	mA
	$I_O = 5\text{ mA to }1\text{ A}$				0.5	
Short-circuit output current		25°C		400		mA
Peak output current		25°C		2.2		A

- (1) Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.
- (2) This parameter is validated by design and verified during product characterization. It is not tested in production.

## μA7812 Electrical Characteristics

at specified virtual junction temperature,  $V_I = 19\text{ V}$ ,  $I_O = 500\text{ mA}$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_J^{(1)}$	μA7812C			UNIT
			MIN	TYP	MAX	
Output voltage	$I_O = 5\text{ mA to }1\text{ A}$ , $V_I = 14.5\text{ V to }27\text{ V}$ , $P_D \leq 15\text{ W}$	25°C	11.5	12	12.5	V
		0°C to 125°C	11.4		12.6	
Input voltage regulation	$V_I = 14.5\text{ V to }30\text{ V}$	25°C		10	240	mV
	$V_I = 16\text{ V to }22\text{ V}$			3	120	
Ripple rejection <sup>(2)</sup>	$V_I = 15\text{ V to }25\text{ V}$ , $f = 120\text{ Hz}$	0°C to 125°C	55	71		dB
	$V_I = 15\text{ V to }25\text{ V}$ , $f = 120\text{ Hz (KCT)}$			61		
Output voltage regulation	$I_O = 5\text{ mA to }1.5\text{ A}$	25°C		12	240	mV
	$I_O = 250\text{ mA to }750\text{ mA}$			4	120	
Output resistance	$f = 1\text{ kHz}$	0°C to 125°C		0.018		Ω
Temperature coefficient of output voltage	$I_O = 5\text{ mA}$	0°C to 125°C		–1		mV/°C
Output noise voltage	$f = 10\text{ Hz to }100\text{ kHz}$	25°C		75		μV
Dropout voltage	$I_O = 1\text{ A}$	25°C		2		V

- (1) Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.
- (2) This parameter is validated by design and verified during product characterization. It is not tested in production.

## uA7812 Electrical Characteristics (continued)

at specified virtual junction temperature,  $V_I = 19\text{ V}$ ,  $I_O = 500\text{ mA}$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_J^{(1)}$	μA7812C			UNIT
			MIN	TYP	MAX	
Bias current		25°C		4.3	8	mA
Bias current change	$V_I = 14.5\text{ V to }30\text{ V}$	0°C to 125°C			1	mA
	$I_O = 5\text{ mA to }1\text{ A}$				0.5	
Short-circuit output current		25°C		350		mA
Peak output current		25°C		2.2		A

## uA7815 Electrical Characteristics

at specified virtual junction temperature,  $V_I = 23\text{ V}$ ,  $I_O = 500\text{ mA}$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_J^{(1)}$	μA7815C			UNIT
			MIN	TYP	MAX	
Output voltage	$I_O = 5\text{ mA to }1\text{ A}$ , $V_I = 17.5\text{ V to }30\text{ V}$ , $P_D \leq 15\text{ W}$	25°C	14.4	15	15.6	V
		0°C to 125°C	14.25		15.75	
Input voltage regulation	$V_I = 17.5\text{ V to }30\text{ V}$	25°C		11	300	mV
	$V_I = 20\text{ V to }26\text{ V}$			3	150	
Ripple rejection <sup>(2)</sup>	$V_I = 18.5\text{ V to }28.5\text{ V}$ , $f = 120\text{ Hz}$	0°C to 125°C	54	70		dB
	$V_I = 18.5\text{ V to }28.5\text{ V}$ , $f = 120\text{ Hz}$ (KCT)			60		
Output voltage regulation	$I_O = 5\text{ mA to }1.5\text{ A}$	25°C		12	300	mV
	$I_O = 250\text{ mA to }750\text{ mA}$			4	150	
Output resistance	$f = 1\text{ kHz}$	0°C to 125°C		0.019		Ω
Temperature coefficient of output voltage	$I_O = 5\text{ mA}$	0°C to 125°C		–1		mV/°C
Output noise voltage	$f = 10\text{ Hz to }100\text{ kHz}$	25°C		90		μV
Dropout voltage	$I_O = 1\text{ A}$	25°C		2		V
Bias current		25°C		4.4	8	mA
Bias current change	$V_I = 17.5\text{ V to }30\text{ V}$	0°C to 125°C			1	mA
	$I_O = 5\text{ mA to }1\text{ A}$				0.5	
Short-circuit output current		25°C		230		mA
Peak output current		25°C		2.1		A

(1) Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.

(2) This parameter is validated by design and verified during product characterization. It is not tested in production.

## uA7824 Electrical Characteristics

at specified virtual junction temperature,  $V_I = 33\text{ V}$ ,  $I_O = 500\text{ mA}$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_J^{(1)}$	μA7824C			UNIT
			MIN	TYP	MAX	
Output voltage	$I_O = 5\text{ mA to }1\text{ A}$ , $V_I = 27\text{ V to }38\text{ V}$ , $P_D \leq 15\text{ W}$	25°C	23	24	25	V
		0°C to 125°C	22.8		25.2	
Input voltage regulation	$V_I = 27\text{ V to }38\text{ V}$	25°C		18	480	mV
	$V_I = 30\text{ V to }36\text{ V}$			6	240	
Ripple rejection <sup>(2)</sup>	$V_I = 28\text{ V to }38\text{ V}$ , $f = 120\text{ Hz}$	0°C to 125°C	50	66		dB

(1) Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.

(2) This parameter is validated by design and verified during product characterization. It is not tested in production.

## μA7824 Electrical Characteristics (continued)

at specified virtual junction temperature,  $V_I = 33\text{ V}$ ,  $I_O = 500\text{ mA}$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_J^{(1)}$	μA7824C			UNIT
			MIN	TYP	MAX	
Output voltage regulation	$I_O = 5\text{ mA to }1.5\text{ A}$	25°C		12	480	mV
	$I_O = 250\text{ mA to }750\text{ mA}$			4	240	
Output resistance	$f = 1\text{ kHz}$	0°C to 125°C		0.028		Ω
Temperature coefficient of output voltage	$I_O = 5\text{ mA}$	0°C to 125°C		-1.5		mV/°C
Output noise voltage	$f = 10\text{ Hz to }100\text{ kHz}$	25°C		170		μV
Dropout voltage	$I_O = 1\text{ A}$	25°C		2		V
Bias current		25°C		4.6	8	mA
Bias current change	$V_I = 27\text{ V to }38\text{ V}$	0°C to 125°C			1	mA
	$I_O = 5\text{ mA to }1\text{ A}$				0.5	
Short-circuit output current		25°C		150		mA
Peak output current		25°C		2.1		A

## APPLICATION INFORMATION

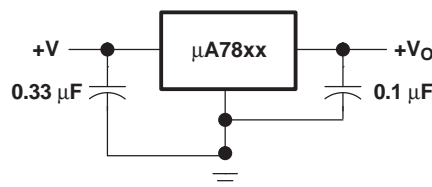


Figure 2. Fixed-Output Regulator

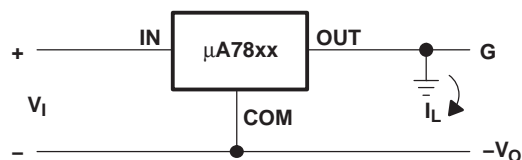
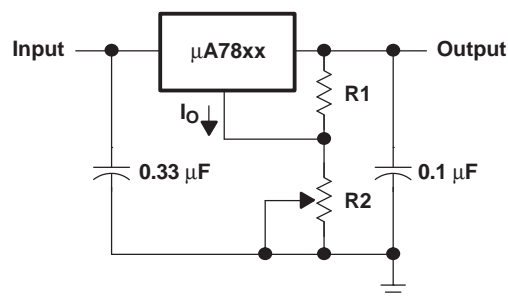


Figure 3. Positive Regulator in Negative Configuration ( $V_I$  Must Float)



A: The following formula is used when  $V_{xx}$  is the nominal output voltage (output to common) of the fixed regulator:

$$V_O = V_{xx} + \left( \frac{V_{xx}}{R1} + I_Q \right) R2$$

Figure 4. Adjustable-Output Regulator



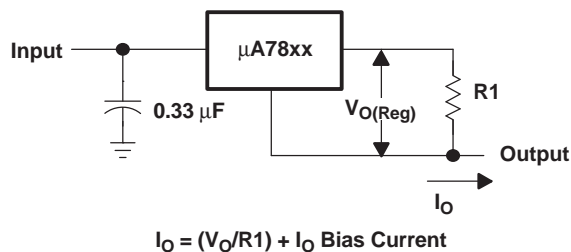


Figure 5. Current Regulator

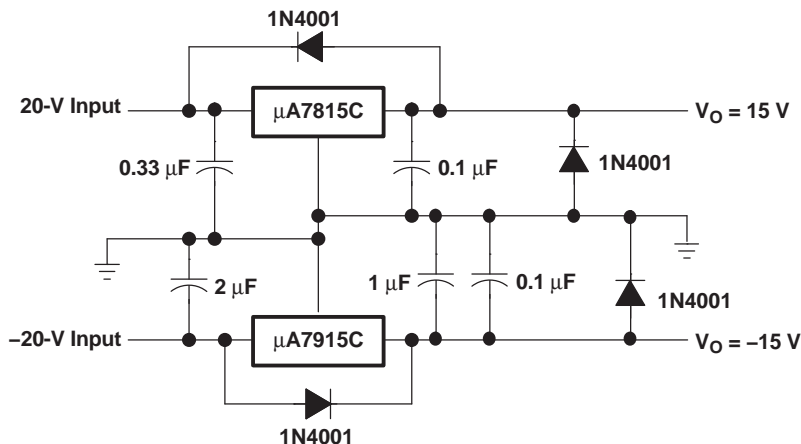


Figure 6. Regulated Dual Supply

### Operation With a Load Common to a Voltage of Opposite Polarity

In many cases, a regulator powers a load that is not connected to ground but, instead, is connected to a voltage source of opposite polarity (e.g., operational amplifiers, level-shifting circuits, etc.). In these cases, a clamp diode should be connected to the regulator output as shown in Figure 7. This protects the regulator from output polarity reversals during startup and short-circuit operation.

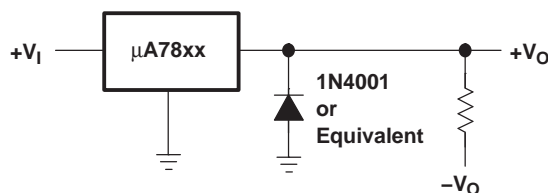
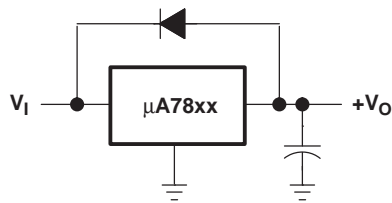


Figure 7. Output Polarity-Reversal-Protection Circuit

### Reverse-Bias Protection

Occasionally, the input voltage to the regulator can collapse faster than the output voltage. This can occur, for example, when the input supply is crowbarred during an output overvoltage condition. If the output voltage is greater than approximately 7 V, the emitter-base junction of the series-pass element (internal or external) could break down and be damaged. To prevent this, a diode shunt can be used as shown in Figure 8.



**Figure 8. Reverse-Bias-Protection Circuit**

## REVISION HISTORY

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Changes from Revision M (January 2009) to Revision N	Page
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- |   |                   |
|---|-------------------|
| • Added KCT package and orderable part number to the ORDERING INFORMATION table. .... | <a href="#">2</a> |
|---|-------------------|
- 

Changes from Revision N (June 2012) to Revision O	Page
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- |   |                   |
|---|-------------------|
| • Added KCT Orderable Part Numbers for 8V & 12V ..... | <a href="#">2</a> |
|---|-------------------|
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## IMPORTANT NOTICE

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